Ministry of Higher Education and Scientific Research

Diyala University College of medicine

Echo Cardiographic Evaluation in Patients with Hypertension

Submitted to the Council of the College of Medicine, Diyala University, In Partial Fulfillment of Requirements for the Bachelor Degree in medicine and general surgery.

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(هُوَ الَّذِي بَعَثَ فِي الْأُمِّيِّينَ رَسُولًا مِنْهُمْ يَتْلُو عَلَيْهِمْ آيَاتِهِ وَيُزَكِّيهِمْ وَيُعَلِّمُهُمُ الْكِتَابَ وَالْحِكْمَةَ وَإِنْ كَانُوا مِنْ قَبْلُ لَفِي ضَلَالٍ مُبِينٍ) .

"سورة الجمعة، آية: 2" .

Abstract

Background: Systemic hypertension leads to hypertensive heart disease. Left ventricular hypertrophy (LVH) is a result of chronic systemic pressure overload. Although systolic function is preserved in early stages, it deteriorates gradually. LVH is symmetrical in hypertension. LVH causes different changes in longitudinal, radial and circumferential mechanics in patients with hypertensive patients. Longitudinal strain is significantly decreased, while radial strain is increased. The correct diagnosis of hypertension and precise assessment of cardiovascular risk are essential to give proper treatment in patients with hypertension. Although echocardiography is the second-line study in the evaluation of hypertensive patients, it gives many clues suggesting bad prognosis associated with hypertension, including increased left ventricular (LV) mass, decreased LV systolic function, impaired LV diastolic function, and increased left atrial size and decreased function.

Aim: this study was performed to evaluation Echo Cardiographic in Patients with Hypertension in Baqubah general hosoital.

Subject and methods: The current study is cross section study type was carried out in Diyala from 26th of November 2022 to the 28th of March 2023.The samples study design was by simple random sampling.

Results: The total sample of study was (200) patients, there were high percentage of patients Hypertensions with diabetes mellitus (62.5%), and Hypertensions with heart failure (55%), Hypertensions with ischemic heart disease (47.5%) and Hypertensions with asthma (9.5%). most age group with hypertensions was (59-69 years old) in percentage (34%), the moderate is most grade of hypertensions in patients (35%) then mild (32.5%) while normal (20%) and severe (12.5%). most of cases (31%) had hypertensions for (5-10) years, then about (27%) had for more than ten years, about (56%) of cases with hypertensions was male and (44%) was female.

Conclusions: echocardiography is not considered as first line method in all hypertensive patients. However, periodic evaluation of cardiac function or morphology by echocardiography is necessary because of the progressive characteristics of hypertensive cardiomyopathy. The highest percentage of patients Hypertensions with diabetes mellitus. The most age group with hypertensions was 59-69 years old. The moderate is most grade of hypertensions according to this study. Most of cases had hypertensions for (5-10) years. The male is more than female with hypertensions.

Acknowledgment

By the name of Allah, we start our project and I am thankful to Allah for helping me to complete this project and giving us the power and determination to do it faithfully and honestly.

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I should express our gratitude and appreciation to our families and friends for their support to us. I want to thank all the people who accept to provide us with information about our subject.

Finally, thanks to everyone who helped this study to be completed

Dedications

الحمدُ لله الذي لا يبلغُ مِدحتَهُ القائلونَ، ولا يُحصي نعماءهُ العادُّون، ولا يؤدِّي حقهُ المجتهدونَ ،والصلاة والسلام على خير البرية ومعلم البشرية وعلى آله الغر الميامين.

الحمد لله الذي وفقني لتوثيق هذه الخطوة المهمة في مسيرتي العلمية لتكون ثمرة جهد كبير -بفضله تعالى و ببركة رسوله وآله (عليهم السلام)- مهداة إلى أبي و أمي حفظهما الله نورا لدربي وسراجا أهتدي به في المسالك الحالكة ، وإلى من هم سندي و متكأي وأعضادي "أخوتي" الذين هونوا عليَّ عناء المشوار وعقباته. . .

إلى رفيقات الدرب اللاتي قاسمنني لحظاته بحلوها ومرها . . .

إلى أساتذتي الكبار وأهل الفضل الذين أتحفوني بمعلوماتهم القيمة وأخص بالذكر مشرفي الأستاذ الدكتور (**احمد مذب عذاب**) الذي لم يألُ جهدا في مد يد العون و المساندة. .

إلى كل هؤلاء أهديهم بحثي هذا ، وأرجو من الله التوفيق و السداد .

Contents

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Introduction

Cardiovascular diseases are major leading health problems in the world, and hypertension is a major risk factor for cardiovascular diseases and stroke which have significantly higher morbidity and mortality [1].

Although the echocardiographic examination is usually recommended as a second-line study in the evaluation of hypertensive patients, it is one of most commonly used imaging modality and has given insights into pathophysiology and clinical implications in patients with hypertension. It can detect anatomical and functional changes easily in a real-time, quick, and reproducible manner. Echocardiography is more sensitive for the detection of asymptomatic organ damage that can be used as a determinant of cardiovascular risk, So it is important in the clinical management in selected hypertensive patients [2].

In the 2013 ESH/ESC Guidelines for the management of arterial hypertension, echocardiography is the second-line study based on medical history, physical examination, and findings from routine laboratory tests, the guidelines recommended performing echocardiographic examination in patients who are suspected with having left ventricular hypertrophy (LVH), left atrial (LA) dilatation, or concomitant heart diseases (class IIb: usefulness/efficacy is less well established by evidence/opinion, level C: consensus of opinion of the experts and/or small studies, retrospective studies, and registries [3].

The 2014 Canadian Hypertension Education Program (CHEP) guidelines recommended the echocardiographic use in the selected patients, Routine echocardiographic study is not recommended in all patients with hypertension (grade D: recommendations are based on expert opinion alone). However, the echocardiographic examination for the evaluation of

LVH is useful in selected patients to define the future cardiovascular risk (grade C: recommendations are based on trials that have lower levels of internal validity and/or precision, trials reporting invalidated surrogate outcomes, or results from non-randomized observational studies). Echocardiographic evaluation of LV mass and systolic and diastolic LV function is recommended in patients with hypertension suspected to have LV dysfunction or coronary artery disease (grade D), LV ejection fraction (LVEF) should be assessed objectively by an echocardiogram or nuclear imaging in patients with hypertension and evidence of heart failure (grade D [4].

The latest guideline of the Eighth Joint National Committee (JNC 8) did not mention about the use of echocardiography [5]. The previous guideline of JNC 7 discussed about the echocardiographic examination to detect LVH in the assessment of cardiovascular risk [6].

Indications to the use of echocardiography in the management of hypertensive patients remain vague, The committee of the scientific associations participating in the 2017 US guidelines explicitly indicates that the echocardiographic study is not recommended for evaluation and management of hypertensive adults. The European guidelines are more flexible and give a specific indication to echocardiography for detection of left ventricular hypertrophy (LVH), which might be extensively extended to LV geometry, to influence treatment decisions. This is a reasonable recommendation, although it is unclear when clinical decisions can be really influenced by evidence of LVH. Presence of LVH in hypertensive patients strongly influences cardiovascular prognosis, and its regression/progression is associated with lower/higher incidence of cardiovascular events, Thus, its detection should force therapy to decrease blood pressure (BP) to <130 mm Hg, but whether to refer

patients to echocardiography laboratories to resolve this doubt remains largely arbitrary [7].

As a consequence of this ambiguity, one question remains unanswered: Should all patients with hypertension be screened with echocardiogram for LVH, At present, there is no clinical trial evidence addressing these questions, and the few expert opinions found in literature did not modify the present trend [8].

One possibility to help decide whether to refer hypertensive patients for echocardiography in the clinical practice might be that of being guided by the pretest ("preechocardiography") probability of LVH, this would be particularly appealing in those patients less likely to have LVH as a consequence of a normal ECG, these patients generally represent a relatively low-risk category, which, however, has been shown to present a significant prevalence of LVH on echocardiography [9].

Systemic hypertension causes hypertensive heart disease. Chronic systemic pressure loading results in left ventricular hypertrophy (LVH) in order to maintain normal wall stress. In earlier stages of hypertension systolic function is preserved. But, in later stages or with concomitant coronary artery disease (CAD), systolic function is also impaired [10].

The echocardiographic findings related with hypertension are as follows: Left ventricular hypertrophy, diastolic dysfunction, left atrial dilatation, systolic dysfunction, mitral anular calcification, aortic sclerosis, and aortic root dilatation [11].

Left Ventricular Hypertrophy is evaluated with echocardiography by measuring left ventricular mass (LVM) and left ventricular (LV) geometry. These parameters are measured:

1. Septal thickness/Posterior wall thickness

2. Relative wall thickness

3. LVM/Body surface area (BSA) 4) LV geometry

ASE/EAE guidelines have set cut off limits for LVH as:

LV septal wall thickness ≥ 0.9 cm for women and ≥ 1.0 cm for men.

Mild LVH as: LV septal thickness 1.-1.2 cm/1.1-1.3 cm, moderate LVH as: 1.3-1.5 cm/1.4-1.5 cm, and severe LVH as: ≥ 1.6 cm/ ≥ 1.7 cm (Figures 1 and 2).

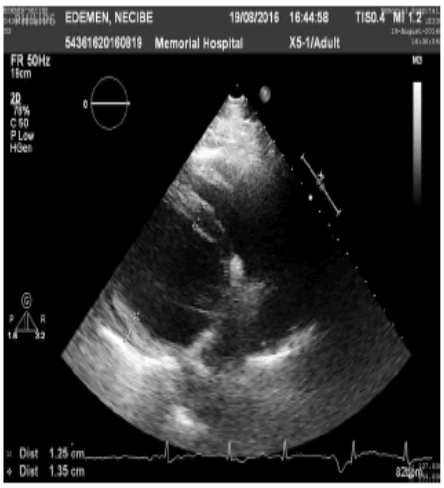

Figure 2: Example to moderate LVH.

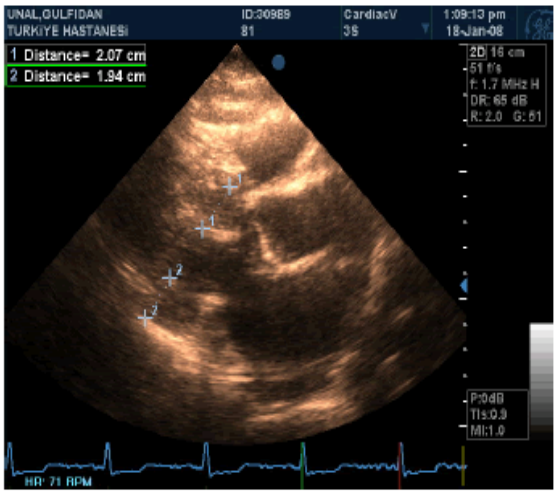

Figure 1: Example to severe LVH.

The formula for relative wall thickness is: (RWT) = (2 × PWTd) / LVIDd

RWT ≥ 0.42 is considered as concentric and RWT <0.42 is considered as eccentric.(LV mass (gram) = 0.8 × 1.04 × ((LVIDd+PWTd+SWTd)3-LVIDd3) + 0.6.

The cut of points for LVM/BSA are: 115 g/m2 for men and 95 g/m2 for women [10].

Concentric LV hypertrophy is characterized by normal cavity size, symmetrically increased wall thickness and increased LVM. This type of hypertrophy is seen in hypertension. The presence of concentric hypertrophy is associated with increased cardiovascular events, Long standing hypertension or addition of CAD leads to concentric remodeling: LV shape becomes more rounded and systolic dysfunction occurs. In hypertension, there is pressure overload. Pressure elevation leads to an increase in wall thickness which is known as concentric remodeling [11].

Eccentric hypertrophy: It is due to volume overload. (e.g. with mitral regurgitation) and it is caused by increased diastolic wall stress. As a consequence, length of the cardiac myocytes is increased. Finally, LV is enlarged (Figure 3) [12].

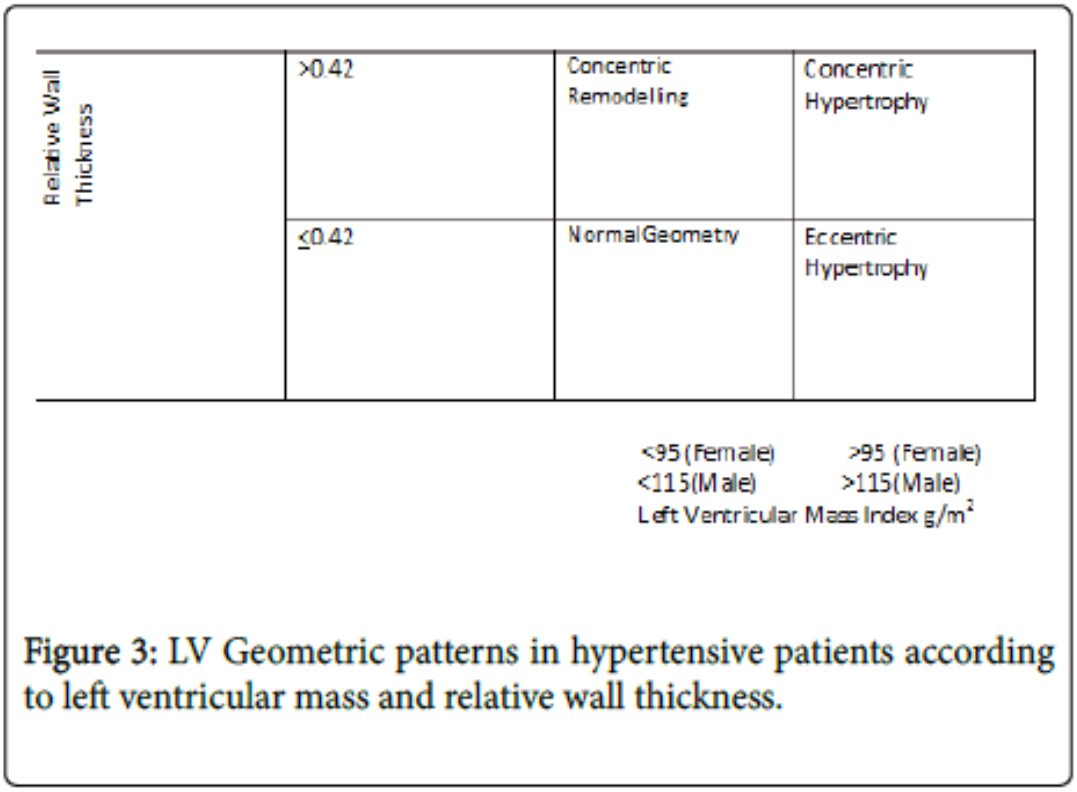

Figure 3: LV Geometric patterns in hypertensive patients according to left ventricular mass and relative wall thickness.

Left ventricular hypertrophy causes different changes in longitudinal, radial and circumferential mechanics in patients with hypertensive patients. Global longitudinal strain is decreased, whereas radial strain is decreased as a compensatory mechanism [13].

Left atrial (LA) size is enlarged in hypertensive patients, Enlarged LA diameter was found >20% of hypertensive patients in a large series, left atrial dilation is related to diastolic dysfunction. Left atrial size is also a predictor of paroxysismal atrial fibrillation in hypertensive patients [14].

LA diameter is measured by M-mode at end ventricular systole when the LA chamber is at its greatest dimension. But enlargement in medial-lateral and superior-inferior diameters alter LA geometry, therefore anteroposterior (AP) dimension may not reflect LA size correctly [15].

Recent studies have shown that measurement of left atrial strain (SR) with speckle tracking may be useful in determining left atrial function in hypertensive patients, according to the studies, it has been shown that LA strain values are lower in hypertensive patients when compared to normal, irrespective to the presence of LA enlargement or LVH. Decrease in SR values are present in all three phases of LA function [16].

Reason for LA dysfunction in hypertensive patients is explained by the chronic pressure exposure of the LA, LA pressure rise and reduction of reservoir and conduit functions, In early hypertensive disease LA stretching causes a temporary enhancement of LA pump function. When compliance is lost and stiffness increases, LA contractility decreases. In later stage, LA mechanics can be depressed in all three phases [17].

Left atrial function assessment may be done using the following methods:

1. Volumetric methods
2. Spectral Doppler
3. Tissue Doppler
4. Deformation analysis (SR imaging).

During the cardiac cycle, LA acts as a reservoir receiving pulmonary venous flow during ventricular systole, as a conduit transferring blood passively during ventricular early diastole, and as an active pump in late diastole.

LA reservoir function corresponds to S' tissue velocity wave and s strain (total), LA conduit function corresponds to E' tissue velocity wave and e strain (strain positive), and LA booster pump function corresponds to A' tissue velocity wave and a strain (strain negative) [18].

In earliest stages of the disease, systolic function is preserved unless coronary artery disease accompanies. Small, hypertrophic left ventricle is typical for this form of the disease. Sometimes small late systolic mid cavity obliteration is seen. The duration of this gradient is smaller than the one seen in hypertrophic cardiomyopathy [19].

However, recent studies using 2D speckle tracking strain demonstrate that impaired myocardial systolic deformation occurs in hypertensive patients. Therefore, systolic left ventricular longitudinal strain decreases in the early stages of left ventricular remodeling [20].

Multidimensional deformation is involved in patients with hypertrophy or those with elevated LV filling pressure. Even though Left ventricular ejection fraction (LVEF) is preserved, left ventricular myocardial deformation starts early. This myocardial deformation has been associated with subendocardial fibrosis [21].

Another issue is the compensatory increase in left ventricular twist in the early phase of systolic dysfunction. LV twists decreases as LV systolic function deteriorates, Mitral annular calcification is frequently seen in chronic hypertensive patients [22].

Aortopathy in hypertension

Aortic root dilatation is a common finding for hypertensive patients. Aortic anulus dilatation is seen in progressed disease. According to a meta-analysis, the prevalence of aortic root dilatation in hypertensive patients is about 10%. It may be due to accelerated vascular aging pathway, where increased blood pressure causes fragmentation of elastin, In a recent study, it has been shown that systemic hypertension is positively associated with larger aortic diameter at all considered levels, independent of age, sex and BSA [23].

Right ventricle

Measures of right ventricular deformation are reduced in patients with LVH secondary to hypertension. So, LVH may cause early sub clinical RV dysfunction as well. 2D myocardial deformation is found to be affected by LV geometry in hypertensive patients [18]. In another study, abnormal renin-angiotensin-aldosterone system has been associated with RV dysfunction in systemic hypertension [24].

Dipper and non-dipper blood pressure

Non dipper blood pressure pattern is defined as blood pressure decrease in night time is less than10%. Studies have shown that nondipper blood pressure pattern may be associated with increased left ventricular mass, impaired left ventricular and right ventricular function. Therefore, it carries a higher risk for cardiovascular events [25].

Stress echocardiography

LVH is an important reason for false positive results in exercise electrocardiography or SPECT tests. But, it has not been shown to affect the accuracy of stress echocardiography, in patients with hypertension, a hypertensive response to exercise does not seem to affect the false positive result of exercise echo. Exercise echocardiography might be a good test to perform to detect CAD in hypertensive patients [26].

Methods

Ethical and Approval Consideration: Permission was taken from patients to fill the information required and they were assured regarding the confidentiality of their responses. The Reason of the study was explained and only those who agreed to participate are included in the study.

Study Population: The study was performed among patients in internal medicine consultant at Baqubah General Hospital.

Study design: The current study is cross section study type was carried out in Diyala from 26th of November 2022 to the 28th of March 2023.The samples study design was by simple random sampling.

Sample technique and data collection: Trained very well to interview the questionnaire carefully and in scientific way. Respondents were assured that the information obtained would be confidential and used only for statistical purposes.

Questionnaire and Interview: the questionnaire used for data collection was designated in (English) language.

Data Analysis and Presentation: All data management and analysis was done by using manual statistical methods. Data have been represented b suitable tables and figures.

The sample: The sample was 200 from patients in Baqubah General Hospital.

Results

The total sample of study was (200) patients, in this study male was 112 and female was 88, the mean of age was 50 years old, and the minimum of age was 37 years old and maximum of age was 74 years old.

Table 1: The number of patients with HT and chronic disease.

With hypertensions	Number %
Hypertensions with diabetes mellitus	125 (62.5%)
Hypertensions with asthma	19 (9.5%)
Hypertensions with heart failure	110 (55%)
Hypertensions with ischemic heart disease	98 (47.5%)
Total	200

This table shows that there were high percentage of patients Hypertensions with diabetes mellitus (62.5%), and Hypertensions with heart failure (55%), Hypertensions with ischemic heart disease (47.5%) and Hypertensions with asthma (9.5%).

Table 2: The distributions of patients according to age.

Age	Number %
37-47 years old	40 (20%)
48-58 years old	57 (28.5%)
59-69 years old	68 (34%)
> **69 years old**	35 (17.5%)

This table shows that most age group with hypertensions was (59-69 years old) in percentage (34%), then (48-58) years old in percentage (28.5%), while age group (37-47) years old was (20%) and age group older than 69 years old was (17.5%).

Table 3: The distributions of patients according to grading of hypertensions (myocardial thickness).

Normal (0.9-1.2) cm	Mild (1.2-1.5) cm	Moderate (1.5-2) cm	Severe (>2) cm
40 (20%)	65 (32.5%)	70 (35%)	25 (12.5%)

This table shows that the moderate is most grade of hypertensions in patients (35%) then mild (32.5%) while normal (20%) and severe (12.5%).

Table 4: The distributions of patients according to durations of hypertensions.

Years durations	Number %
< 1 year	34 (17%)
1-5 year	50 (25%)
5 - 10 year	62 (31%)
> 10 year	54 (27%)

This table shows that most of cases (31%) had hypertensions for (5-10) years, then about (27%) had for more than ten years, while (25%) of cases had hypertensions for (1-5) years and only (17%) with hypertensions for less than one years.

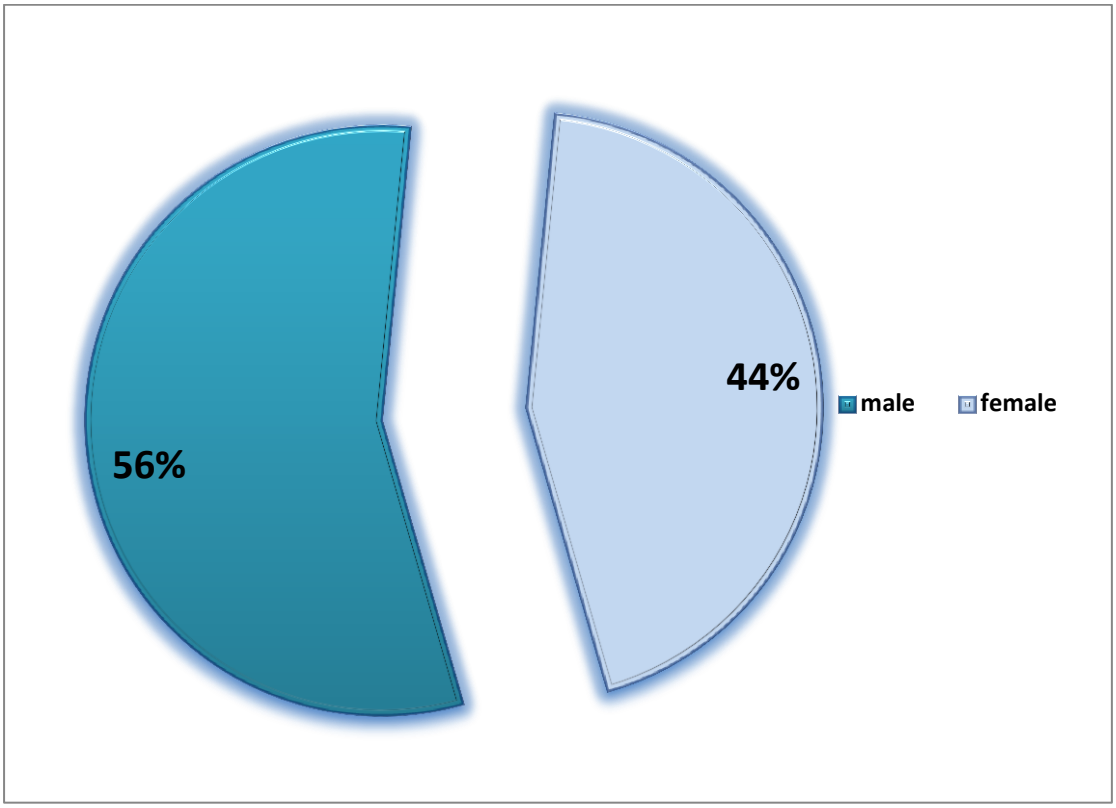

Figure 1: The distributions of patients according to the gender.

This figure shows that about (56%) of cases with hypertensions was male and (44%) was female.

Discussion

Hypertension remains a major contributor to the global burden of disease. The measurement of blood pressure continues to have pitfalls related to both physiological aspects and acute variation. As the left ventricle (LV) remains one of the main target organs of hypertension, and echocardiographic measures of structure and function carry prognostic information in this setting, the development of a consensus position on the use of echocardiography in this setting is important.

The total sample of study was (200), that there were high percentage of patients Hypertensions with diabetes mellitus (62.5%), and Hypertensions with heart failure (55%), Hypertensions with ischemic heart disease (47.5%) and Hypertensions with asthma (9.5%).

In other study was conducted in Daejeon, Korea [27], approximately same percentage most of patients with hypertensions had DM (69%), then heart failure (60%), while Hypertensions with ischemic heart disease (51%) and Hypertensions with asthma (15%).

Patients with hypertension often exhibit insulin resistance and are at greater risk of diabetes developing than are normotensive individuals. The major cause of morbidity and mortality in diabetes is cardiovascular disease, which is exacerbated by hypertension. Accordingly, diabetes and hypertension are closely interlinked because of similar risk factors, such as endothelial dysfunction, vascular inflammation, arterial remodelling, atherosclerosis, dyslipidemia, and obesity. There is also substantial overlap in the cardiovascular complications of diabetes and hypertension related primarily to microvascular and macrovascular disease. Common mechanisms, such as upregulation of the renin-angiotensin-aldosterone system, oxidative stress, inflammation, and activation of the immune

system likely contribute to the close relationship between diabetes and hypertension.

In the present study, that most age group with hypertensions was (59-69 years old) in percentage (34%), then (48-58) years old in percentage (28.5%), this percentage similar to results in study conducted in Istanbul, Turkey [28], that that most age group with hypertensions was (59-69 years old) (39%), then (48-58) years old in percentage (33%).

In this study, the moderate is most grade of hypertensions in patients (35%) then mild (32.5%) while normal (20%) and severe (12.5%). Also same in study of Daejeon, Korea [27], that moderate is the most grade in percentage (31%).

In the present study (56%) of cases with hypertensions was male and (44%) was female.

Also in study of Napoli, Italy [29], that the male with hypertensions was (60%) and female was (40%).

Conclusions

According to the most recent guidelines, it is stated that initiation or monitoring the response to hypertensive therapy is based on clinical parameters. Therefore, echocardiography is not considered as first line method in all hypertensive patients. However, periodic evaluation of cardiac function or morphology by echocardiography is necessary because of the progressive characteristics of hypertensive cardiomyopathy.

The highest percentage of patients Hypertensions with diabetes mellitus.

The most age group with hypertensions was (59-69 years old).

The moderate is most grade of hypertensions according to this study.

Most of cases had hypertensions for (5-10) years.

The male is more than female with hypertensions.

Because echocardiography can detect cardiac morphologic and hemodynamic change caused by systemic arterial hypertension, echocardiography is a powerful tool for the evaluation of target organ damage, which is essential for the evaluation of cardiovascular risk. Although echocardiography is not an essential first-line imaging study, echocardiography is an excellent tool for the assessment of future cardiovascular risks. Because of its non-invasiveness and easy accessibility.

Recommendations

conventional echocardiography has many pitfalls in the interpretation of several echocardiographic parameters. To overcome this limitation, physicians should be aware of the pitfalls of conventional echocardiographic parameters. Second, doctors should analyze and interpret echocardiographic findings in conjunction with other findings from physical examination and routine examinations. Third, it is worthwhile for medical practitioners to learn other newer echocardiographc modalities. Aside from conventional echocardiographic modalities, newer echocardiographic methods including tissue Doppler imaging, strain echocardiography, or three-dimensional echocardiography also have been introduced to evaluate hypertensive patients providing valuable information about the extent of cardiac damages thus helping us to give better treatment.

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force, american society of echocardiography, american heart association, american society of nuclear cardiology, heart failure society of america, heart rhythm society, society for cardiovascular angiography and interventions, society of critical care medicine, society of cardiovascular computed tomography, society for cardiovascular magnetic resonance american college of chest physicians. *J Am Soc Echocardiogr*. 2011;**24**:229–67.

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